HYDROLOGY (DRAINAGE) STUDY

Casa de Verde Apartments
1121 Greenfield Drive
El Cajon, California 92021
S06-036 & R06-012

APN: 484-101-84

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Project #A61114W1

February 28, 2008

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ATTACHMENTS

1.0 INTRODUCTION

The proposed project site is located just outside the City of El Cajon in the County of San Diego. The site is approximately 1.0 mile west of Highway 67 and 0.70 miles north of Interstate 8. The project site is located on undeveloped land bordered on the west, south, and east by residential properties and by Greenfield Drive on the on the north (please refer to Figure 1). The Assessor's Parcel number (APN) for the project lot is 484-101-08. This drainage study calculates the peak stormwater discharge leaving the project site (onsite and offsite drainage) in the existing condition and after development.

2.0 PROJECT SITE DESCRIPTION

The total area of the project site is approximately 0.447 acres. The elevation of the proposed project site ranges from approximately 478 feet above mean sea level (MSL) to 483 feet MSL.

The site is fairly flat, with most slopes ranging from 0 to 2 percent. The southern perimeter has a short, steeper downslope several feet wide (see Figures 4 and 5). The project site area is currently undeveloped, except for a small paved area of about 4080 square feet more or less at the northern entrance, which is the remnant of a parking lot. The remainder of the project site is bare dirt and gravel, with a narrow, patchy strip of grass on the east and south. The proposed site will have about 4700 square feet of roof area and about 6850 square feet of asphalt parking. The site has approximately 20% impervious ground area. Stormwater run-on to the site is restricted due to topography and by the small size of the site. The total site drainage area (including offsite run-on) is approximately 0.549 acres. Run-on occurs from a broad area immediately east of the project site. There are no existing storm drains or conveyances on the project property. The nearest storm drain is a curb inlet on Greenfield Drive, approximately 250 feet west of the project site.

3.0 METHODOLOGY

Stormwater runoff was calculated using the Rational Method as outlined in the San Diego County Hydrology Manual, dated June 2003. Stormwater runoff was calculated for an existing and post-development condition resulting from the 100-year, 6-hour storm event, the 10-year, 6-hour storm event, and the 85th percentile, 24-hour storm event for the project and its drainage area. Standard intensity-duration curve data was used for the San Diego region supplied in the Manual. Manning's equation was used for channel flow and Figure 7 was used for shallow concentrated flow velocities. A new Time of Concentration (Tc) was calculated at each subarea to improve accuracy. Refer to Appendix A for Hydraulic Calculation sheets and equations used.

The soil group used for the site and in the drainage area is soil hydrologic type C (see Appendix B for soils information).

Pre-Development Methods

For the purposes of flow calculation, the 0.549-acre drainage area in the existing condition was divided into 4 subareas; A though D (see Figure 4 and Table 5.1). Subarea A was defined as the upstream or initial drainage subarea. Runoff from this area was assumed to be sheet flow, up to the maximum length allowed in the SD Hydrology Manual, and then shallow concentrated flow. For higher concentrated flows at the most downstream drainage areas (subarea C) Manning's equation for natural channels was used.

Post-Development Methods

Post-development, the drainage area was divided into four subareas, A through D. Due to the very small size of the drainage area, it was assumed that the initial time of concentration (Ti) is quite small, and a value of 5.0 minutes was used (which is the recommended minimum in the San Diego County Hydrology Manual). Estimated travel time was added to this to produce the total Tc. Peak discharges at the three outlet locations were calculated.

4.0 EXISTING CONDITION HYDROLOGY

The existing subarea, including offsite run-on is approximately 0.549 acres. Runoff from Subarea A continues west to Subarea B, where it crosses the site and exits at Outlet 2 at the western boundary. Subarea C represents the area of runoff that exits the site to the north at Greenfield Drive. Flow was assumed to be shallow concentrated flow across the site and natural channel flow along the southern boundary. Subarea D represents the area that drains to the south down the short slope. Flow in this subarea was assumed to be shallow concentrated flow. Total discharge from the project site in the existing condition was calculated at 1.34 cfs (cubic feet per second) for the 100-year storm precipitation, 0.92 cfs for the 10-year, and 0.31 cfs for the 85th percentile storm. Refer to Figure 4 for drainage map, Appendix A for Hydraulic Calculations, and Table 5.1 for results, including discharges and velocities at each outlet.

5.0 POST- DEVELOPMENT HYDROLOGY

After project development, drainage will be impacted by the grading of the site for development and the increase in impervious area. The site will be graded such that runoff will be split the lot, with runoff from the northern portions of the site (Subareas A, C and D) flowing north to Greenfield Drive, and runoff from the southern portion (Subarea B) will flow to the south and then west to exit the site at the southwest corner. Runoff from the northerly building rooftops (Subareas A, D and a portion of C) will split to the east and west and will be directed into grassy landscaped areas where they will flow north, pass through gravel strips, and into vegetated areas in the project site. Flow was assumed to be sheet flow at the most upstream portions of the site (i.e., over the building roofs), turning to shallow concentrated flow further downstream, then to channel flow when (if) flow reaches the grassy swales on the southeast and southwest and the concrete swale in the northern parking lot.

The development of the project site will increase the impervious area of the site from an undeveloped level of approximately 30% to a developed level of approximately 82%. This will cause an increase in runoff after development. Total peak discharge from the project site after development was calculated at 2.56 cfs for the 100-year storm, 1.75 cfs for the 10-year, and 0.57 cfs for the 85th percentile storm. See Figure 5 for drainage map and Table 5.1 for pre- and post-development discharges.

Drainage directions will not be significantly altered. Runoff from the site will still be split near the middle with drainage from the northern portion of the site flowing north, and drainage from the southern portion of the site flowing south and west. The rate of runoff exiting the site to the north Subareas A, C and D will increase from 0.89 cfs to 2.15 cfs for the 100-year storm. Runoff from the parking lot (Subarea C) after development will be directed into a BioClean® filter flume to help remove sediment and hydrocarbons from the runoff before it leaves the site and via a spillway and at the north end of the parking to a standard 3-foot D-25 curb outlet. Runoff from Subareas A and D will flow north over the driveway and parkway via sheet flow and exit the site at Greenfield Drive.

The discharge from the southwest (over privately owned property) will decrease from 0.48 to 0.41 cfs for the 100-year storm. Additionally, runoff from the southwest after development will be concentrated at one point instead of spread over a broader area. To further help mitigate the discharge, runoff to the south will be directed into landscaped areas on the east and west and over one of two gravel strips as it travels south. This will also reduce velocity and erosion potential. Additionally, at the southwest outlet, runoff will enter a 12" x 12" grate inlet catch basin equipped with a BioClean® grate inlet skimmer box filter and will exit the site through an 8-inch PVC pipe. It will continue over grassy areas to the west where it will eventually enter North First Street.

Table 5.1

Outlet	Q100 Peak Discharge (cfs)		Q100 Avg. Velocity (ft/sec)		85th Percentile Discharge (cfs)		85th Percentile Avg. Velocity (ft/sec)	
	Pre	*Post*	*Pre*	*Post*	*Pre*	*Post*	*Pre*	*Post*
North (Outlet 1)	0.87	2.15	1.3	3.2	0.20	0.48	0.9	2.1
South (Outlets 2&3)	0.48	0.41	2.3	1.4	0.11	0.09	2.3	0.9
Total	1.35	2.56	-	-	0.31	0.57	-	-

6.0 CEQA GUIDELINES OF SIGNIFICANCE

Question 1: Would the project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of stream or river, in a manner which results in substantial erosion or siltation on- or off-site?

Response: No, it will not. Runoff patterns will change slightly due to grading and paving. A proposed concrete masonry unit wall will partially block upstream run-on, but will allow run-on to enter the site through drain holes. This flow will be very low and will

likely be shallow concentrated flow, which is not conducive to erosion or siltation. The other change will be the concentration of the runoff from the south at the southwest corner. The potential for erosion is greater in this area but, again, the flow is very low and the slope is significantly reduced due to the catch basin and pipe drain. Downstream of this outlet are flat, grassy areas that will slow and spread the flow and resist erosion. Flow velocity at the southern outlet will be reduced due to the redirection of the flow perpendicular to the perimeter slope and subsequent decrease in slope. Flow velocity at the northern outlet will increase after development but it will be reduced as it enters the drain inlet catch basin before being conveyed to the street gutter via the curb outlet.

Question 2: Would the project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?

Response: No, it will not. The project will be graded such that flooding onsite will not occur. Discharge off the site will be low and will reach the street gutters without flooding.

Question 3: Would the project create or contribute runoff water which would exceed the capacity of existing or planned storm water drainage systems?

Response: No, it will not. Planned stormwater drainage systems will be designed to accommodate these peak discharges. The existing street gutters and storm drain system will experience only a 1.19 cfs increase in 100-year flows as a result of this project.

Question 4: Would the project place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary delineation map, including County Floodplain Maps?

Response: No, it will not.

Question 5: Would the project place within a 100-year flood hazard structures which would impede or redirect flood flows?

Response: No, it will not.

Question 6: Would the project expose people or structures to a significant risk of loss, injury or death involving flooding as a result of the failure of a levee or dam on-site or off-site?

Response: No, it will not.

7.0 CERTIFICATION

Report Preparation

I certify that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, to the best of my knowledge and belief, the information submitted is true, accurate, and complete.

CIVIL ENGINEER

Lawrence E. Cole, RCE 36292

February 28, 2008
Date

8.0 REFERENCES

1. County of San Diego Department of Public Works Flood Control Section, *San Diego County Hydrology Manual* dated June 2003.

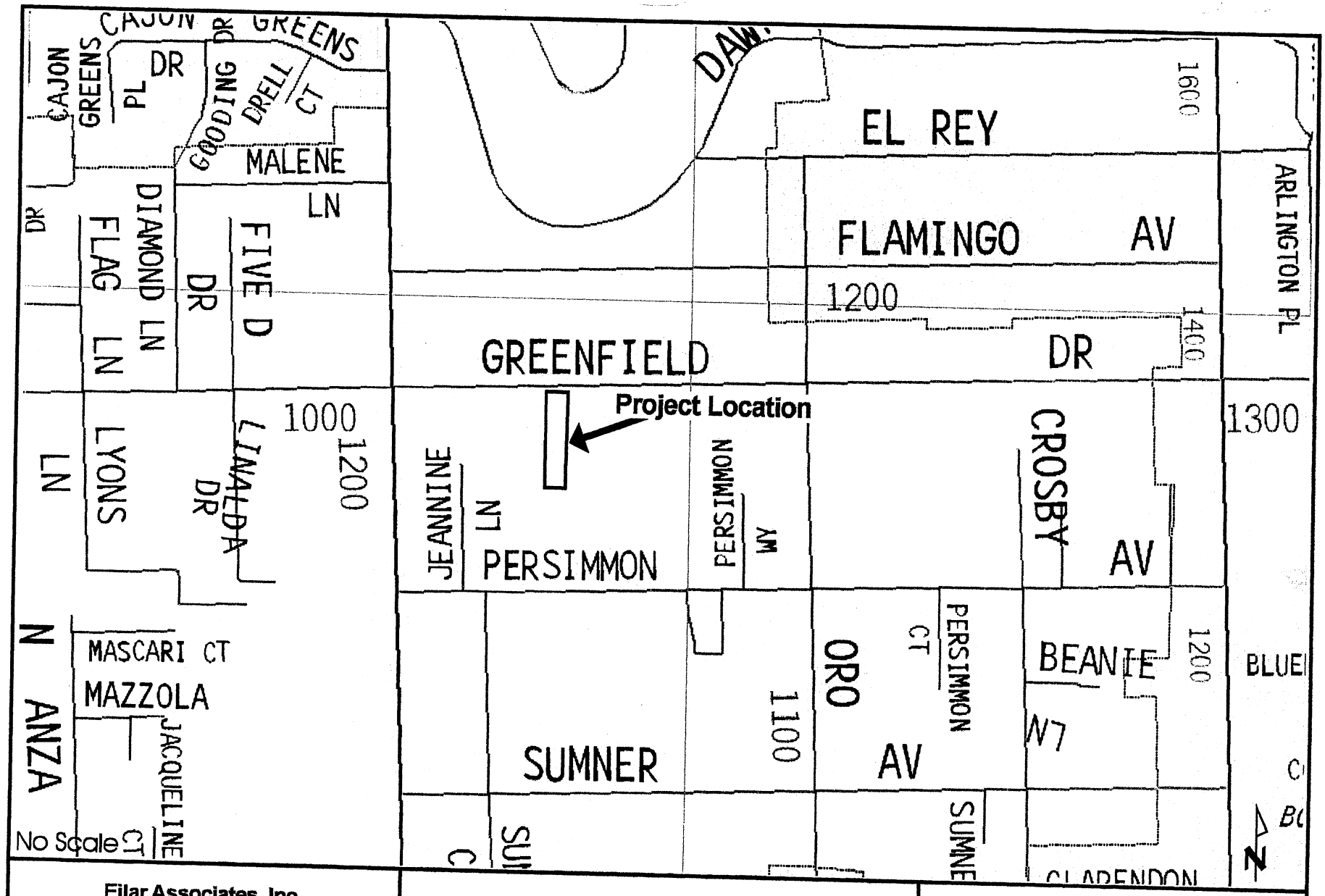
2. USDA Natural Resources Conservation Service, National Cooperative Soil Survey *Web Soil Survey 1.1.*

3. California Environmental Quality Act (CEQA), Public Resources Code Division 13, Sections 21000 *et. seq.*; Guidelines for the California Environmental Quality Act (CEQA), California Code of Regulations Tile 14, Chapter 3, Sections 15000-215387.

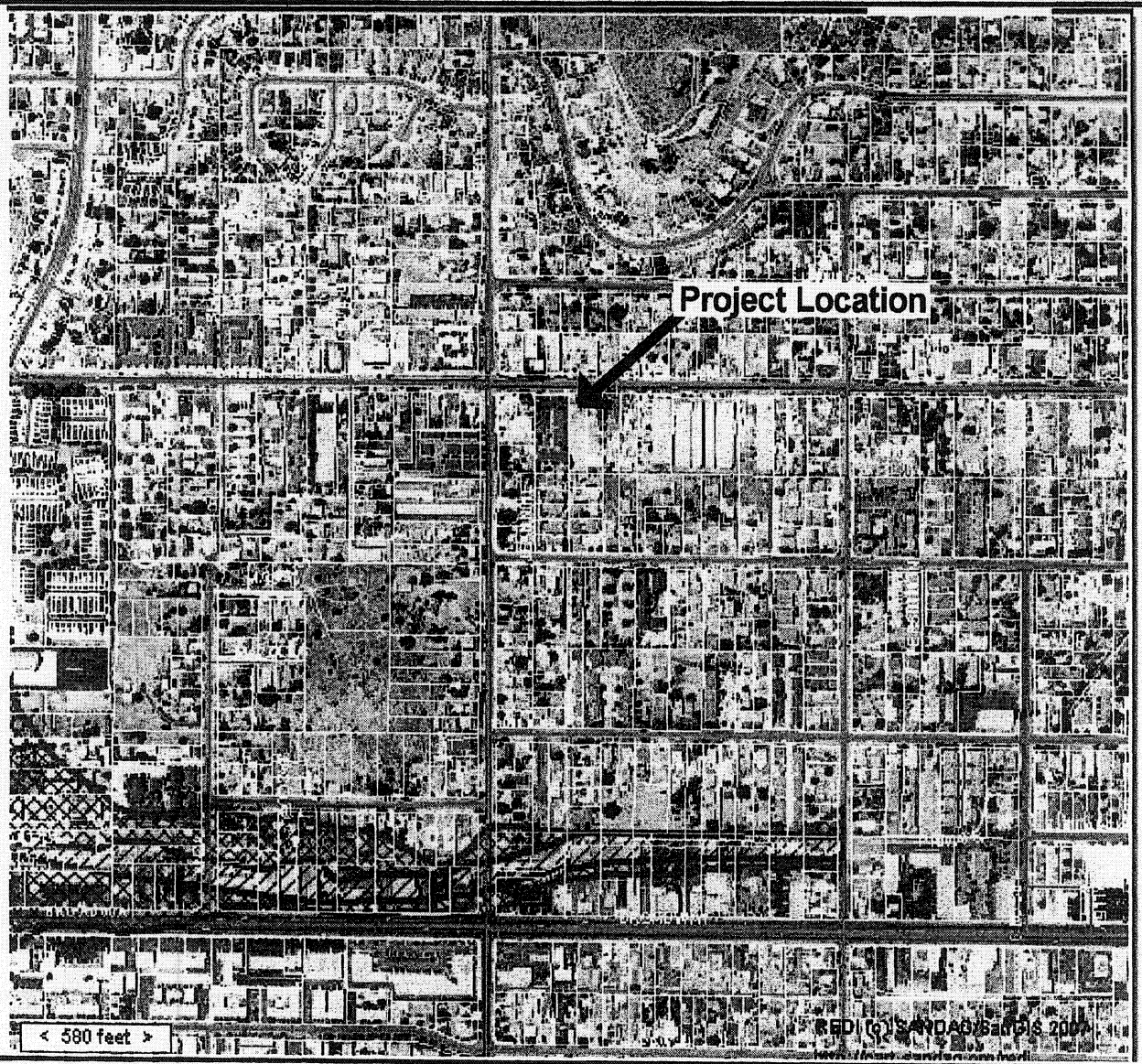
4. County of San Diego *Stormwater Standards Manual*, Appendix A, Section G.

6. County of San Diego, Ordinance No. 9426 and An Ordinance Amending the Code of Regulatory Ordinances Relating to the Addition of the Stormwater Standards Manual.

7. International Erosion Control Association *CPESC Exam Review Course Workbook*, Section 5, dated October 2002.



Eilar Associates, Inc. **539 Encinitas Boulevard, Suite 206** **Encinitas, California 92024** **760-753-1865**	**Vicinity Map** **Job # A61114W1**	**Figure 1**



LEGEND

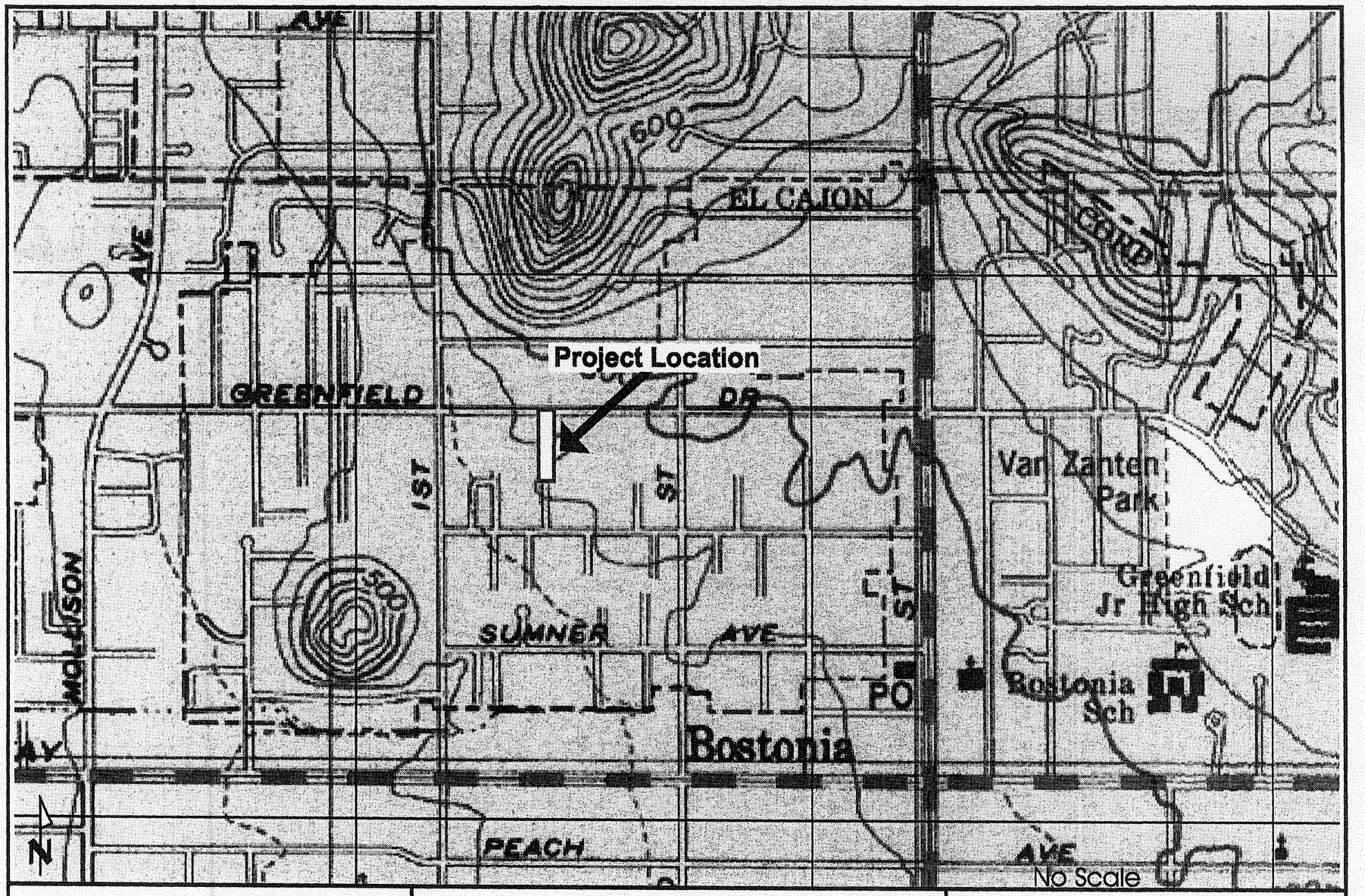
Reference Layers

- Parcels
- Roads
- 100 Yr. Flood Way
- 100 Yr. Flood Plain
- 500 Yr. Flood Plain

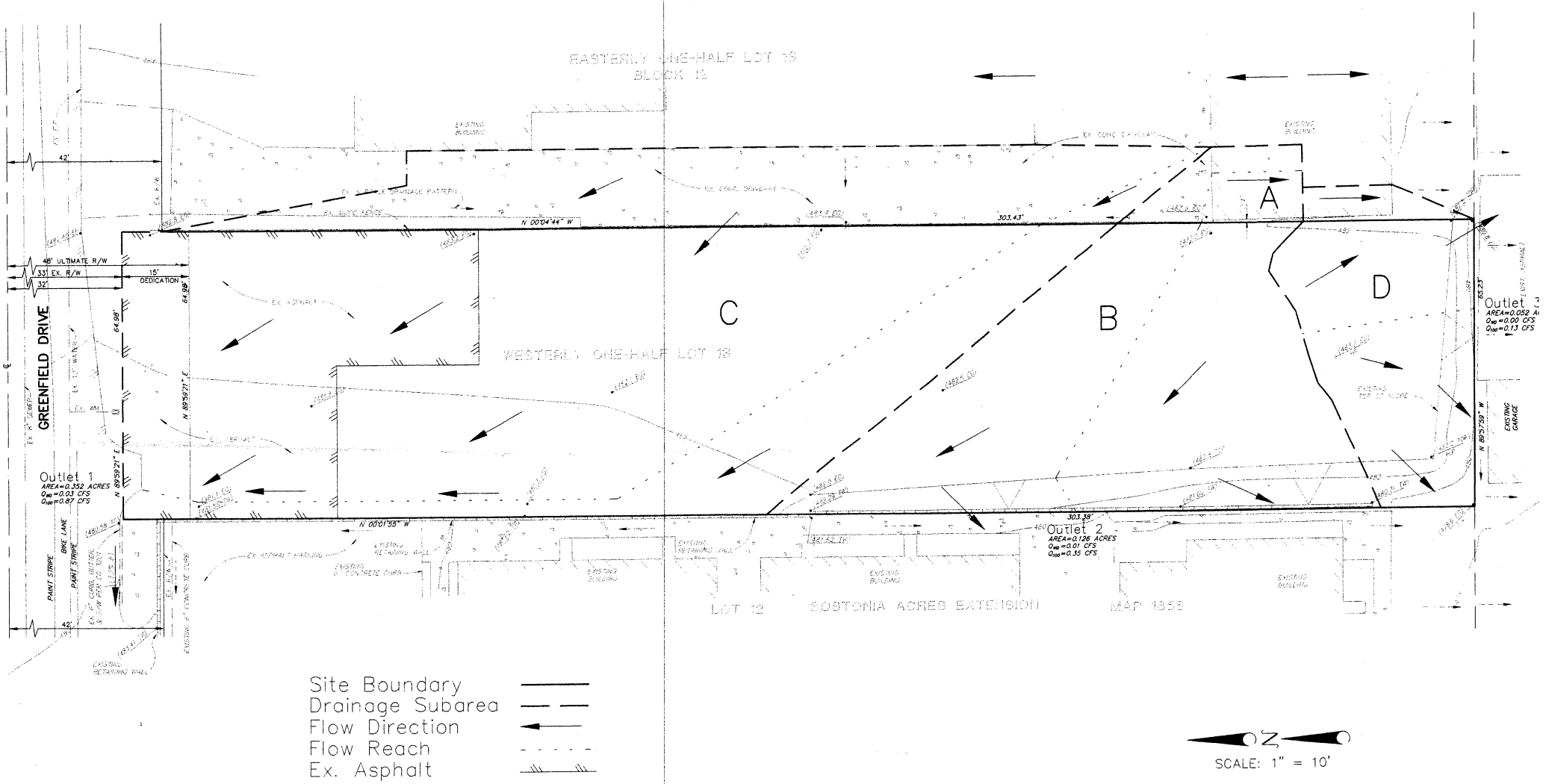
N

Eilar Associates, Inc. 539 Encinitas Boulevard, Suite 206 Encinitas, California 92024 760-753-1865	FEMA Flood Zones Job # A61104W1	Figure 2

Eilar Associates, Inc. 539 Encinitas Boulevard, Suite 206 Encinitas, California 92024 760-753-1865	Satellite Aerial Photograph Job # A61114W1	Figure 3



Eilar Associates, Inc. 539 Encinitas Boulevard, Suite 206 Encinitas, California 92024 760-753-1865	Topographic Map Job # A61104W1	Figure 4



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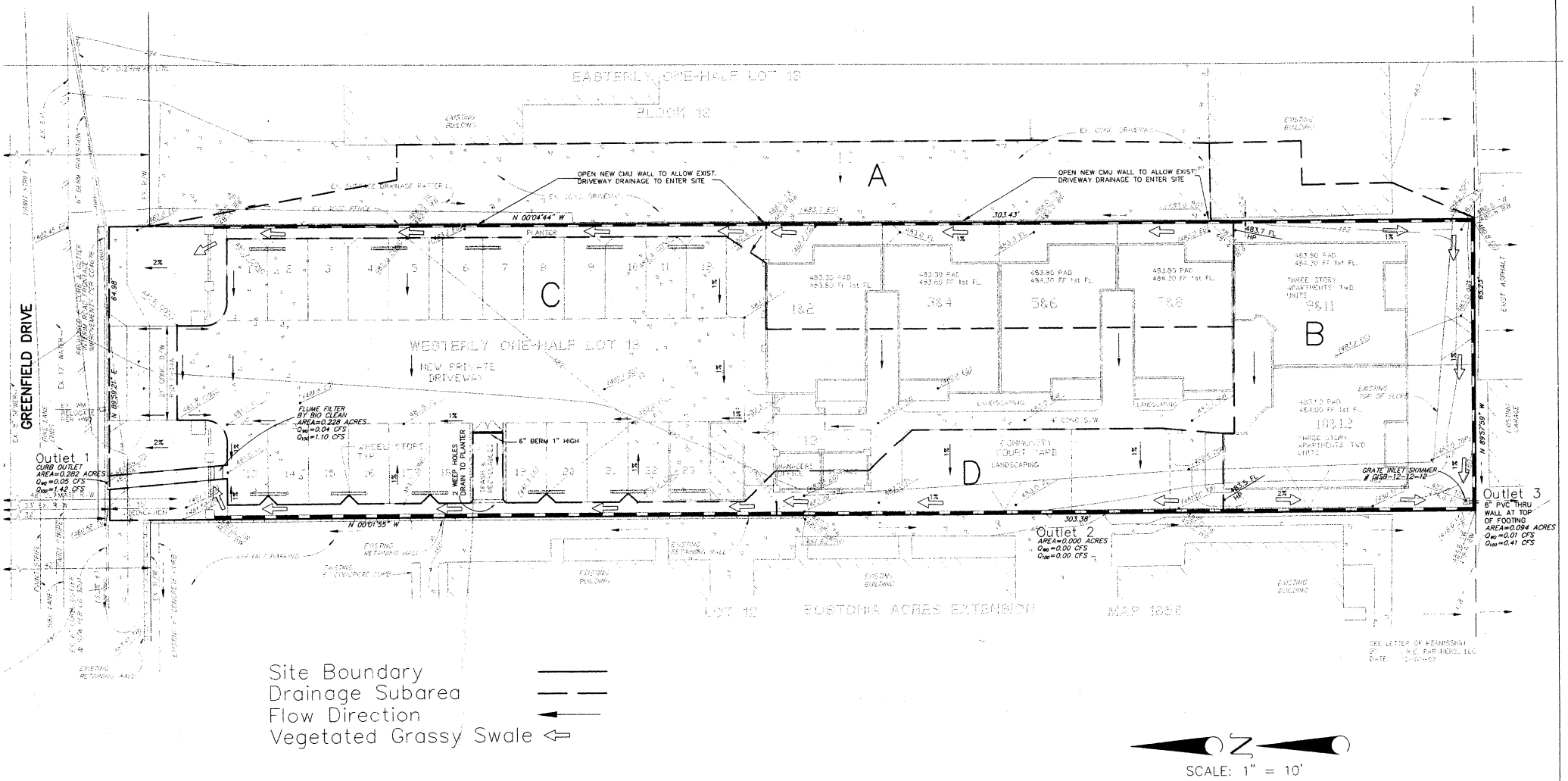
Pre-Development Site Plan and Drainage Area Showing Subareas and Drainage Patterns
Project #A61114W1

Figure 4



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Post-Development Site Plan and Drainage Area Showing Subareas and Drainage Patterns
Project #A61114W1

Figure 5

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service

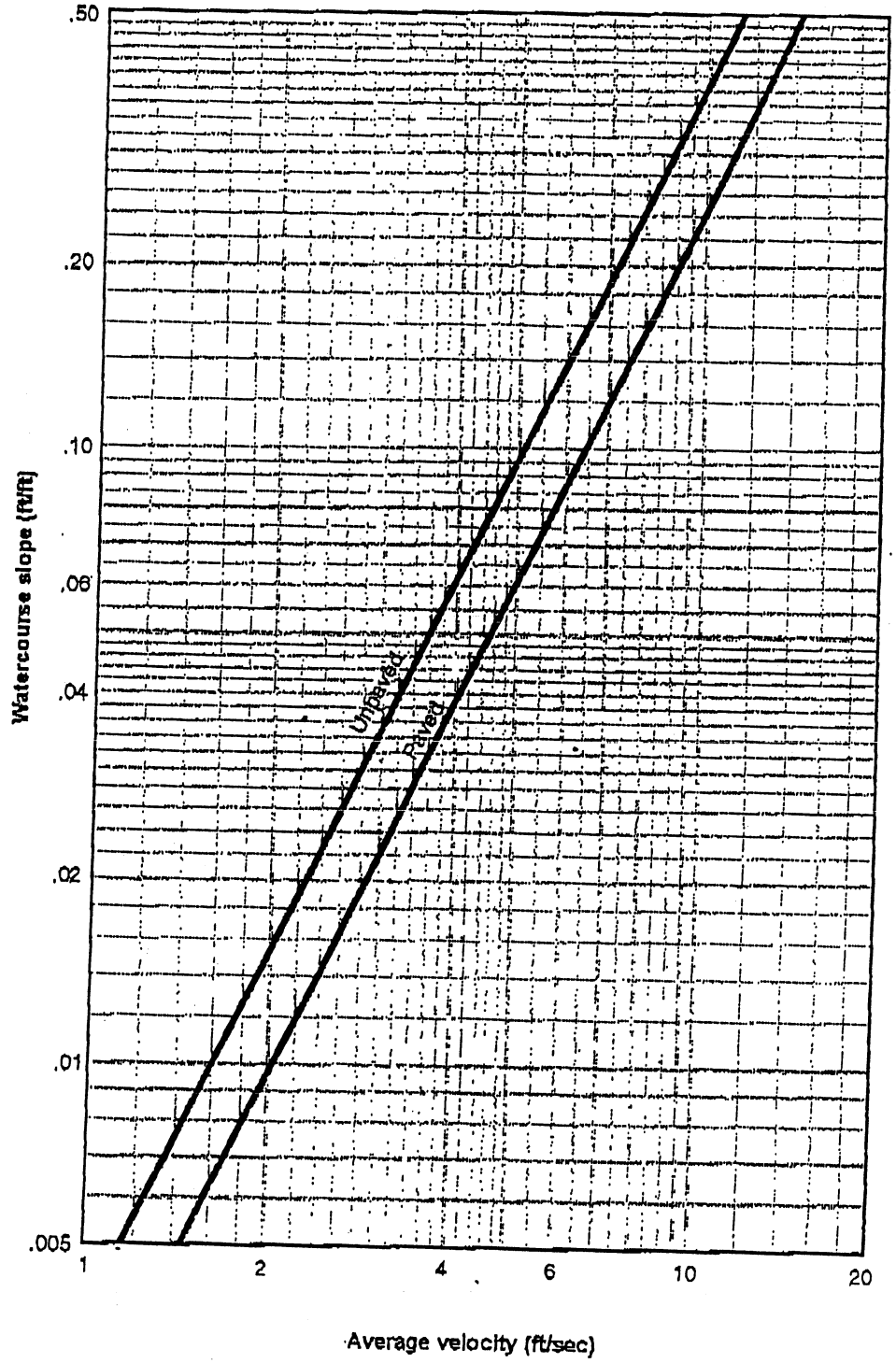

Figure 3-1. – Average velocities for estimating travel time for shallow concentrated flow.

Figure 7

Figure 3–1
Average velocities for estimating travel time
for shallow concentrated flow

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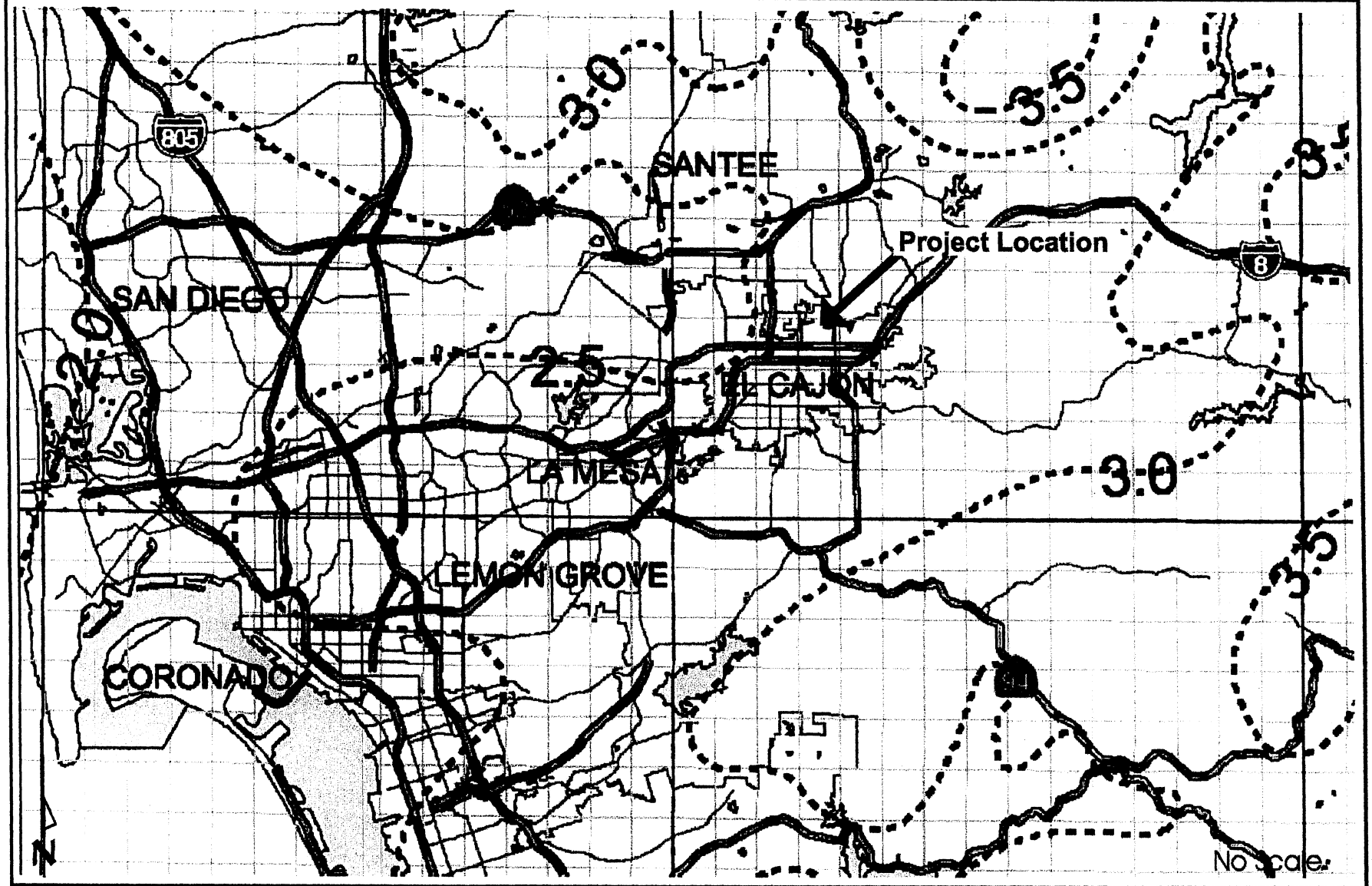
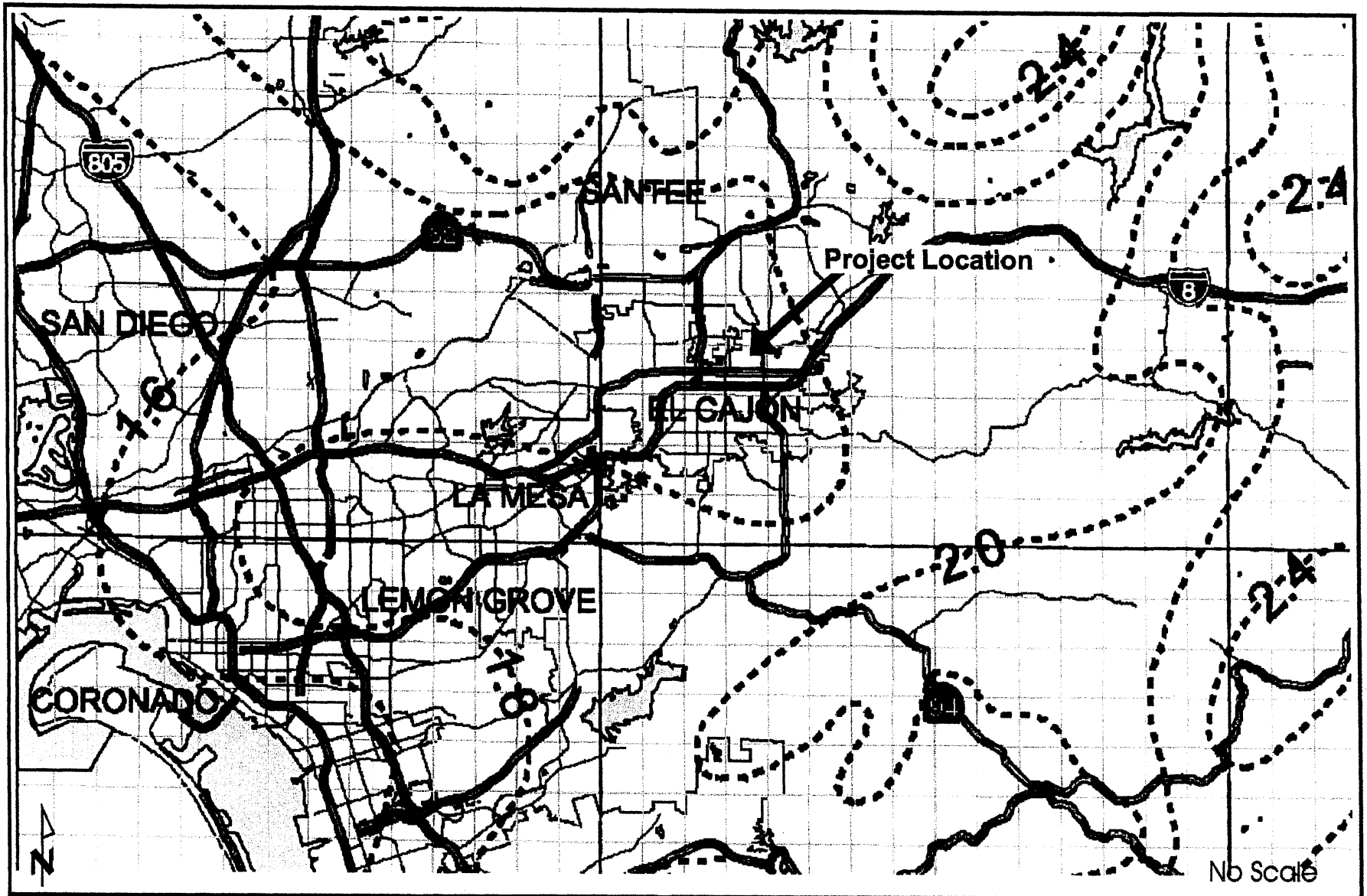
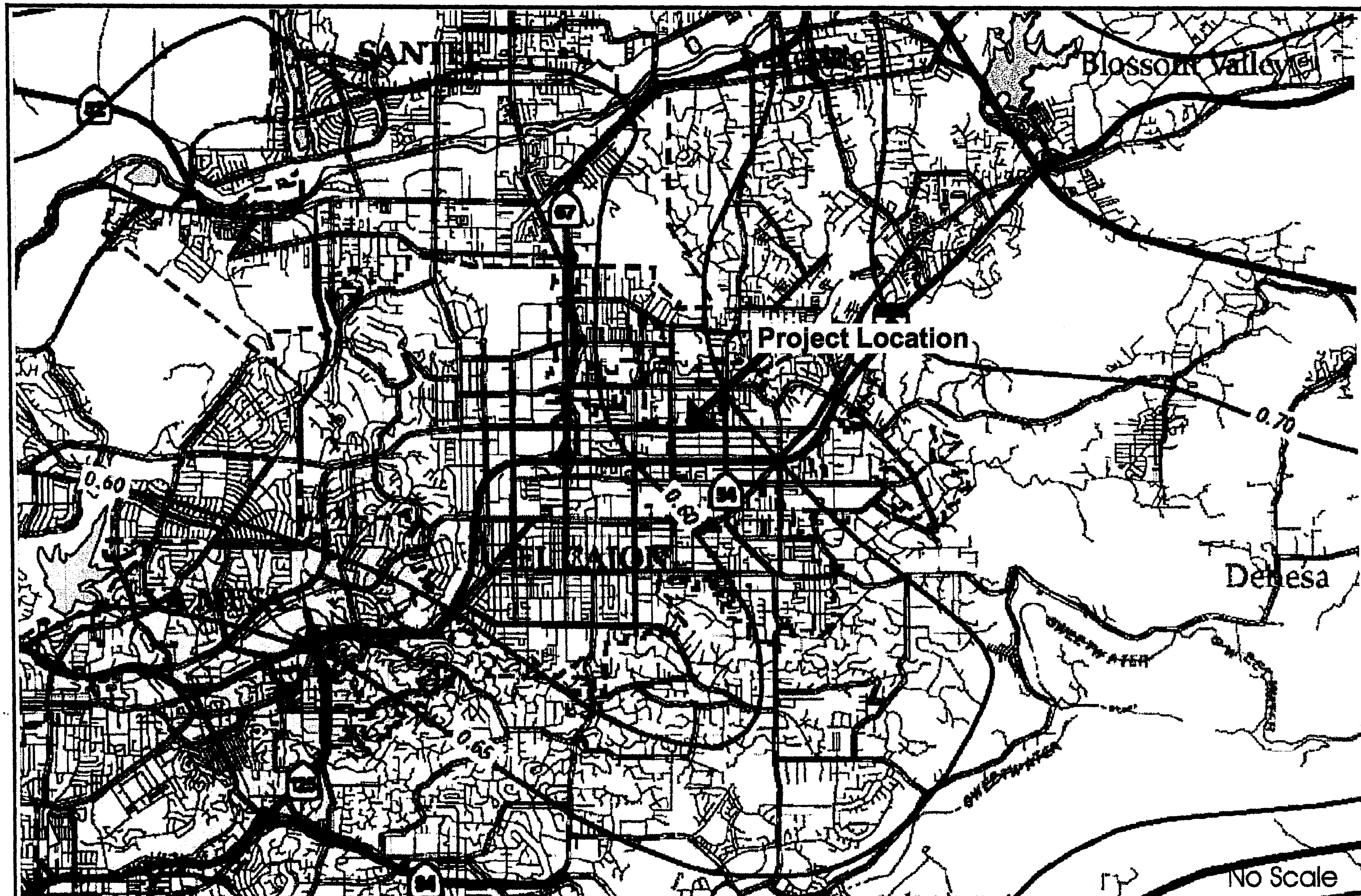


Eilar Associates, Inc. 539 Encinitas Boulevard, Suite 206 Encinitas, California 92024 760-753-1865	100-year, 6-hour storm precipitation (inches) Job # A61114W1	Figure 8



Eilar Associates, Inc. 539 Encinitas Boulevard, Suite 206 Encinitas, California 92024 760-753-1865	10-year, 6-hour storm precipitation (inches) Job # A61114W1	Figure 9



Eilar Associates 539 Encinitas Boulevard, Suite 206 Encinitas, California 92024 760-753-1865	85th Percentile, 24-hour storm precipitation (inches) Job # A61104W1	Figure 10

APPENDIX A

HYDROLOGY CALCULATIONS

Project : Casa de Verde Condominiums

Pre-Development Drainage

Drainage Subarea

A	100-yr, 6-hr	10-yr, 6-hr	85th Percentile	WQ	
*drainage area (acres)	0.018	0.018	0.018	0.018	Description: Initial Subarea
*Delta H (change in elev) (ΔE) (ft)	10	10	10	10	A flows to B
*Length (L) of slope (ft)	34	34	34	34	sheet flow and
*Lm (table 3.2 in SD Hydro)(ft)	100	100	100	100	shallow concentrated flow
*L (adjusted length)(L-Lm)	34	34	34	34	
* Initial Slope (%)	25.0	25.0	25.0	25.0	
*Slope (%)	25.0	25.0	25.0	25.0	
Soil Hydrologic Group	C	C	C	C	
*P6 (from SD hydro maps, see Figure 3.1)	2.6	1.8	0.63	0.63	
*C (run off coefficent from table 3-1 in SD Hydro or calculated using Imperv%)	0.87	0.87	0.87	0.87	95% impervious
Ti(Initial Sheet Flow, minutes)	0.83	0.83	0.83	0.83	Ti =((1.8*(1.1-B17))*(SQRT(B11)))/POWER(B13,1/3)
Velocity (ft/sec)	10.00	11.00	10.00	10.00	from Figure 5
Tt (travel time, minutes)	0.06	0.05	0.06	0.06	for shallow concentrated flow
Tc (time of concentration, minutes)	0.88	0.88	0.88	0.88	$Tc = Tt + Ti$
use 5.0 minute minimum	5.00	5.00	5.00	5.00	
I (Intensity (in/hr)	6.85	4.74	1.66	0.20	$I = 7.44(P_6)(D)^{-0.645}$
Q (cfs)	**0.11**	**0.07**	**0.03**	**0.00**	$Q\ (cfs) = CIA$

* numbers to be entered

Drainage Subarea

B	100-yr, 6-hr	10-yr, 6-hr	85th Percentile	WQ	
*drainage area (acres)	0.126	0.126	0.126	0.126	Description: B flows to Outlet 2
*P6 (from SD hydro maps, see Figure 3.1)	2.6	1.8	0.63	0.63	shallow concentrated flow
Soil Hydrologic Group	C	C	C	C	
*C (run off coefficent from table 3-1 in SD Hydro or calculated using Imperv%)	0.30	0.30	0.30	0.30	0% impervious

*numbers to be entered

Ti (use Tc from above)	5.00	5.00	5.00	5.00	
shallow concentrated flow					
length	78	78	78	78	
slope	2.0	2.0	2.0	2.0	
velocity (ft/sec)	2.3	2.3	2.3	2.3	from Figure 5
Tt (travel time, minutes)	0.57	0.57	0.57	0.57	for shallow concentrated flow
Tc (time of concentration) (minutes)	5.57	5.57	5.57	5.57	$Tc = Tt + Ti$
I (Intensity (in/hr)	6.39	4.43	1.55	0.20	$I = 7.44(P_6)(D)^{-0.645}$
Q (cfs)	**0.24**	**0.17**	**0.06**	**0.01**	$Q\ (cfs) = CIA$
Q (cfs) w/ upstream at Outlet 2	**0.35**	**0.24**	**0.08**	**0.01**	$Q\ (cfs) = CIA$

Drainage Subarea

Description:
C flows to Outlet 1

C	100-yr, 6-hr	10-yr, 6-hr	85th Percentile	WQ	
*drainage area (acres)	0.352	0.352	0.352	0.352	
*P6 (from SD hydro maps, see Figure 3.1)	2.6	1.8	0.63	0.63	
Soil Hydrologic Group	C	C	C	C	
*C (run off coefficent from table 3-1 in SD Hydro or calculated using Imperv%)	0.48	0.48	0.48	0.48	30% impervious
*numbers to be entered					
Ti (use Tc from subarea A)	5.00	5.00	5.00	5.00	
shallow concentrated flow (paved)					
length	45	45	45	45	
slope	1.3	1.3	1.3	1.3	
velocity (ft/sec)	2.3	2.3	2.3	2.3	from Figure 5
Tt (travel time, minutes)	0.33	0.33	0.33	0.33	for shallow concentrated flow
shallow concentrated flow (unpaved)					
length	113	113	113	113	
slope	1.2	1.2	1.2	1.2	
velocity (ft/sec)	1.8	1.8	1.8	1.8	from Figure 5

Tt (travel time, minutes)	1.06	1.06	1.06	1.06	for shallow concentrated flow
natural channel flow					
length	110	110	110	110	
slope	1.2	1.2	1.2	1.2	
velocity (ft/sec)	1.3	1.1	0.9	0.9	V=Q/(4*((0.59*Q^0.38*0.048^0.38*(B80/100)^-0.19)^2))
Tt (travel time, minutes)	1.44	1.61	2.01	2.01	from Sac. Drainage Manual for modified manning's eq. use η = 0.048
Tc (time of concentration) (minutes)	7.83	8.00	8.40	8.40	$Tc = Tt + Ti$
I (Intensity (in/hr)	5.13	3.50	1.19	0.20	$I = 7.44(P_6)(D)^{-0.645}$
Q (cfs) at Outlet 1	**0.87**	**0.59**	**0.20**	**0.03**	*Q (cfs) = CIA*

Drainage Subarea

D	100-yr, 6-hr	10-yr, 6-hr	85th Percentile	WQ	Description:
*drainage area (acres)	0.052	0.052	0.052	0.052	D flows to Outlet 3
Soil Hydrologic Group	C	C	C	C	shallow concentrated flow
*P6 (from SD hydro maps, see Figure 3.1)	2.6	1.8	0.6	0.6	
*C (run off coefficent from table 3-1 in SD Hydro or calculated using Imperv%)	0.36	0.36	0.36	0.36	10% impervious
Tc (use Tc from subarea A)	5.00	5.00	5.00	5.00	$Tc = Tt + Ti$
I (Intensity (in/hr)	6.85	4.74	1.58	0.20	$I = 7.44(P_6)(D)^{-0.645}$
Q (cfs) at Outlet 3	**0.13**	**0.09**	**0.03**	**0.00**	*Q (cfs) = CIA*
Q (cfs) total peak discharge from site	**1.34**	**0.92**	**0.31**	**0.05**	

Project : Casa de Verde Condominiums

Post-Development Drainage

Drainage Subarea A	100-yr, 6-hr	10-yr, 6-hr	85th Percentile	WQ	Description:
*drainage area (acres)	0.173	0.173	0.173	0.173	A flows to street north along east boundary
*Slope (%)	1.0	1.0	1.0	1.0	
Soil Hydrologic Group	C	C	C	C	
*P6 (from SD hydro maps, see Figure 3.1)	2.6	1.8	0.63	0.63	
*C (run off coefficent from table 3-1 in SD Hydro or calculated using Imperv%)	0.78	0.78	0.78	0.78	81% impervious
Ti(Initial Sheet Flow, minutes)	5.00	5.00	5.00	5.00	
shallow concentrated flow (paved)					
Length (feet)	28	28	28	28	
slope (%)	1.0	1.0	1.0	1.0	
Velocity (ft/sec)	2.00	2.00	2.00	2.00	from Figure 5 for shallow concentrated flow
Tt (travel time, minutes)	0.23	0.23	0.23	0.23	
channel flow					
length (feet)	163	163	163	163	
width (feet)	3.00	3.00	3.00	3.00	
depth (feet)	0.50	0.50	0.50	0.50	
flow depth (feet)	0.28	0.23	0.12	0.12	
slope	0.01	0.01	0.01	0.01	
manning's n	0.035	0.035	0.035	0.035	
velocity (ft/sec)	1.41	1.28	0.90	0.90	
Tt (travel time, minutes)	1.93	2.12	3.02	3.02	
Tc (time of concentration, minutes)	7.16	7.36	8.25	8.25	$Tc = Tt + Ti$
I (Intensity (in/hr)	5.43	3.70	1.20	0.20	$I = 7.44(P_6)(D)^{-0.645}$

Q (cfs)	**0.73**	**0.50**	**0.16**	**0.03** $Q\ (cfs) = CIA$	

* numbers to be entered

Drainage Subarea

B	**100-yr, 6-hr**	**10-yr, 6-hr**	**85th Percentile**	**WQ**	Description
*drainage area (acres)	0.094	0.094	0.094	0.094	B flows to southwest corner
Soil Hydrologic Group	C	C	C	C	
*P6 (from SD hydro maps, see Figure 3.1)	2.6	1.8	0.6	0.6	
*C (run off coefficent from table 3-1 in SD Hydro or calculated using Imperv%)	0.76	0.76	0.76	0.76	76% impervious
Ti (use 5.0 minimum), minutes	5.00	5.00	5.00	5.00	
shallow concentrated flow (paved)					
Length (feet)	20	20	20	20	
slope (%)	1.0	1.0	1.0	1.0	
Velocity (ft/sec)	2.00	2.00	2.00	2.00	from Figure 5 for shallow concentrated flow
Tt (travel time, minutes)	0.17	0.17	0.17	0.17	
shallow concentrated flow (unpaved)					
Length (feet)	40	40	40	40	
slope (%)	1.0	1.0	1.0	1.0	
Velocity (ft/sec)	1.60	1.60	1.60	1.60	
Tt (travel time, minutes)	0.42	0.42	0.42	0.42	
channel flow					
length (feet)	88	88	88	88	
width (feet)	3.00	3.00	3.00	3.00	
depth (feet)	0.50	0.50	0.50	0.50	
flow depth (feet)	0.26	0.22	0.12	0.12	
slope	0.01	0.01	0.01	0.01	
manning's n	0.035	0.035	0.035	0.035	
velocity (ft/sec)	1.37	1.22	0.88	0.88	
Tt (travel time, minutes)	1.07	1.20	1.67	1.67	

$$Tc = Tt + Ti$$

$$I = 7.44(P_6)(D)^{-0.645}$$

Tc (time of concentration, minutes)	6.65	6.79	7.25	7.25	
I (Intensity (in/hr)	5.70	3.89	1.24	0.20	
Q (cfs)	**0.41**	**0.28**	**0.09**	**0.01**	

Drainage Subarea

C	**100-yr, 6-hr**	**10-yr, 6-hr**	**85th Percentile**	**WQ**	
*drainage area (acres)	0.228	0.228	0.228	0.228	Description
Soil Hydrologic Group	C	C	C	C	C flows to filter flume (north)
*P6 (from SD hydro maps, see Figure 3.1)	2.6	1.8	0.6	0.6	concrete channel flow
*C (run off coefficent from table 3-1 in SD Hydro or calculated using Imperv%)	0.81	0.81	0.81	0.81	83% impervious
Ti (use 5.0 minimum), minutes	5.00	5.00	5.00	5.00	
shallow concentrated flow (paved)					from Figure 5
Length (feet)	76	76	76	76	for shallow concentrated flow
slope (%)	1.0	1.0	1.0	1.0	
Velocity (ft/sec)	2.00	2.00	2.00	2.00	
Tt (travel time, minutes)	0.63	0.63	0.63	0.63	
channel flow					
length (feet)	115	115	115	115	
width (feet)	2.00	2.00	2.00	2.00	
depth (feet)	0.33	0.33	0.33	0.33	
flow depth (feet)	0.25	0.20	0.12	0.12	
slope	0.01	0.01	0.01	0.01	
manning's n	0.014	0.014	0.014	0.014	
velocity (ft/sec)	3.20	2.82	2.10	2.10	
Tt (travel time, minutes)	0.60	0.68	0.91	0.91	
Tc (time of concentration, minutes)	6.23	6.31	6.55	6.55	$Tc = Tt + Ti$
I (Intensity (in/hr)	5.94	4.08	1.33	0.20	$I = 7.44(P_6)(D)^{-0.645}$

Q (cfs) at filter flume & curb outlet	**1.10**	**0.75**	**0.25**	**0.04**	*Q (cfs) = CIA*

Drainage Subarea D	**100-yr, 6-hr**	**10-yr, 6-hr**	**85th Percentile**	**WQ**		Description
*drainage area (acres)	0.054	0.054	0.054	0.054		D flows to street north along west boundary
Soil Hydrologic Group	C	C	C	C		
*P6 (from SD hydro maps, see Figure 3.1)	2.6	1.8	0.6	0.6		
*C (run off coefficent from table 3-1 in SD Hydro or calculated using Imperv%)	0.87	0.87	0.87	0.87		95% impervious
Ti (use 5.0 minimum), minutes	5.00	5.00	5.00	5.00		
Tc (minutes)	5.00	5.00	5.00	5.00		
I (Intensity (in/hr)	6.85	4.74	1.58	0.20	$I = 7.44(P_6)(D)^{-0.645}$	
Q (cfs) at street	**0.32**	**0.22**	**0.07**	**0.01**	*Q (cfs) = CIA*	
Q (cfs) Total Peak Discharge from Site	***2.56***	***1.75***	***0.57***	***0.09***		

APPENDIX B

HYDRAULIC CALCULATIONS

HYDRAULIC CALCULATIONS

Curb Inlet (existing offsite in Greenfield Drive) - Capacity

Q = 5.62Lbh^0.5 in sump condition
L = 5 feet
b = 5 inches
h = 5 inches
Capacity of inlet = 7.56 cfs

Circular Pipe - Capacity

Q_{100} = 0.41 cfs (southwest corner)
Propose 6" HDPE pipe
n = .012
S = 0.02
A = 0.196
Wetted perimeter (full) = 1.571'
R = 0.125
Calculated capacity = 0.86 cfs > 0.41 cfs OK!

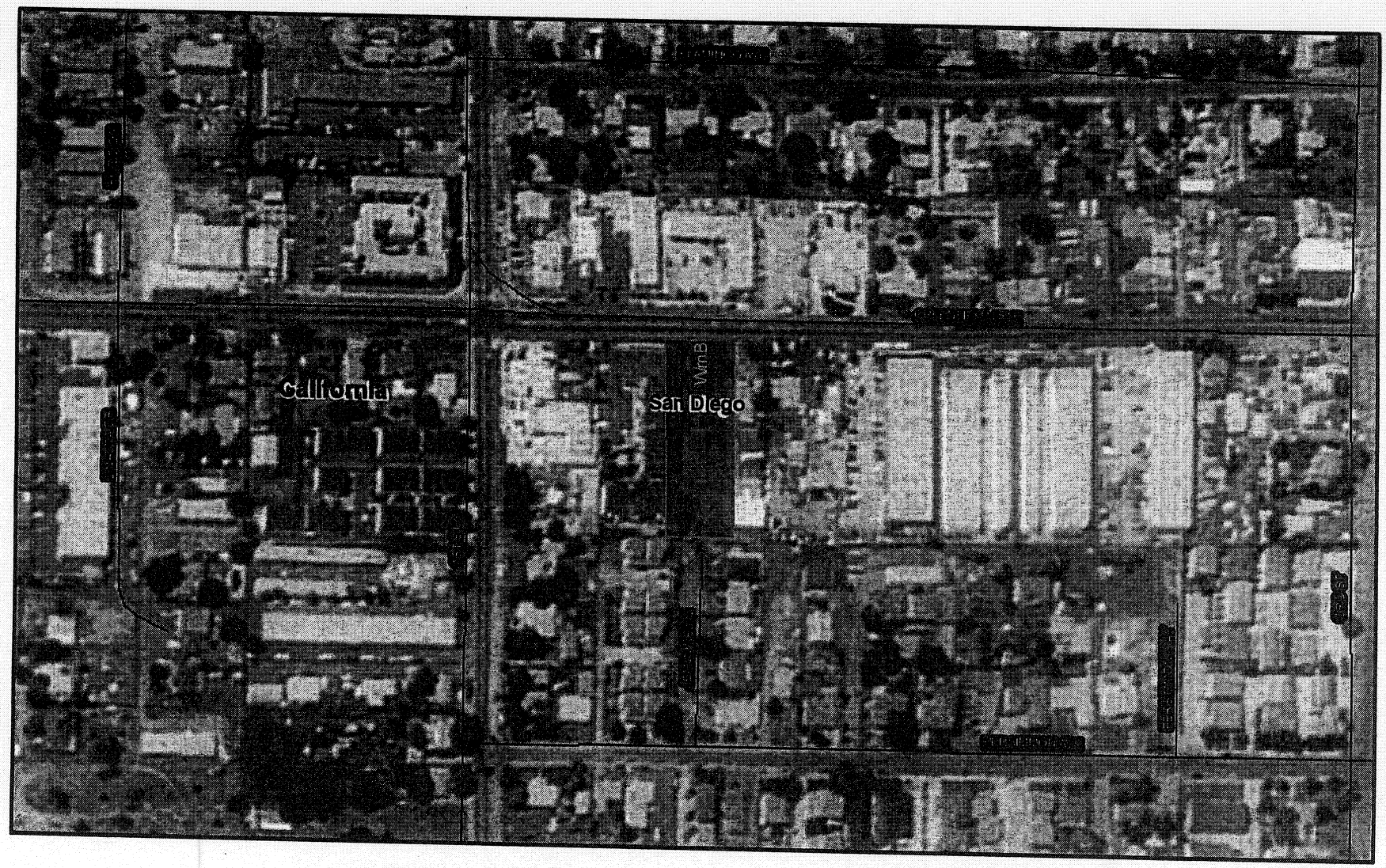
Curb Outlet - Capacity

Q_{100} = 1.10 cfs (north)
D-25 Curb Outlet @ 2.00%.
n = .012
S = 0.02
A = 0.750
Wetted perimeter (full) = 3.5'
R = 0.214
Calculated capacity = 4.72 cfs > 1.10 cfs OK!

APPENDIX C

SOIL HYDROLOGIC GROUPS MAP AND DATA

HYDROLOGIC GROUP RATING FOR SAN DIEGO COUNTY AREA, CALIFORNIA



0 25 50 100 Meters

0 50 100 200 300 400 Feet

USDA Natural Resources Conservation Service

Web Soil Survey 1.1
National Cooperative Soil Survey

HYDROLOGIC GROUP RATING FOR SAN DIEGO COUNTY AREA, CALIFORNIA

MAP LEGEND

Hydrologic Group

{Dominant Condition, <}

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Map Units

- Cities
- Detailed Counties
- Detailed States
- Interstate Highways
- Roads
- Rails
- Water
- Hydrography
- Oceans

MAP INFORMATION

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov

Coordinate System: UTM Zone 11

Soil Survey Area: San Diego County Area, California
Spatial Version of Data: 3
Soil Map Compilation Scale: 1:24000

Map comprised of aerial images photographed on these dates:
5/31/1994

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Tables - Hydrologic Group

Summary by Map Unit - San Diego County Area, California

Soil Survey Area Map Unit Symbol	Map Unit Name	Rating	Total Acres in AOI	Percent of AOI
WmB	Wyman loam, 2 to 5 percent slopes	B	0.7	100.0

Description - Hydrologic Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are placed into four groups A, B, C, and D, and three dual classes, A/D, B/D, and C/D. Definitions of the classes are as follows:

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only soils that are rated D in their natural condition are assigned to dual classes.

Parameter Summary - Hydrologic Group

Aggregation Method: Dominant Condition

Component Percent Cutoff:

Tie-break Rule: Lower